

The effects of music therapy on gross motor functions, pain and level of functional independence in children with cerebral palsy

The effects of music therapy in children with cerebral palsy

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Abstract

Aim: In this study, we aimed to observe the effects of music therapy on gross motor functions, pain, and functional independence measurement in children with cerebral palsy (CP). **Material and Method:** One hundred and twenty children with CP between 5-11 years of age, were randomly divided into a music therapy (MT)+Neurodevelopmental techniques (NDT) group and only NDT group. The children listened to Classical music disc for 45 minutes. Children were treated by NDT while listening to this music. Children were evaluated with Gross Motor Function Measurement (GMFM-88), WeeFIM for functional independence measurement, Wong-Baker faces pain rating scale (FACES) for pain intensity before, at the end of treatment and after 3 months of treatment. The treatments were given 3 times every week, and totally 15 treatments were applied for 5 weeks. **Results:** GMFM, functional independence and pain were also improved in Group MT+NDT. The differences in improvement of creeping and kneeling, standing, and walking were significant between the two groups ($p < 0.001$), showing the effect in Group MT+NDT was better than that in Group NDT. **Discussion:** MT, which is applied additionally in the treatment of children with spastic CP, reduces the pain of children more and increases the gross motor functions and functional capacities according to the rehabilitation program applied alone.

Keywords

Music Therapy; Cerebral Palsy; Gross Motor Functions

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Introduction

Cerebral palsy (CP) is a disorder characterized by cerebral functional impairment, often occurring in children in congenital or perinatal, postnatal periods. According to epidemiological studies, the incidence of CP has been reported to be 2-3 in 1000 liveborns in most communities, although the incidence varies between countries and regions [1]. The studies show that the prevalence is 4.4 per 1,000 live births in Turkey have been made CP [2]. In children with CP, motor disorders, cognitive deficits, visual and speech disorders are also seen [3]. Functional deficits due to these disorders in children with CP make it difficult for children to fulfill their roles in society and thus affect their quality of life [4,5]. Besides the physical limitations of the child, a life-long treatment process can affect psychosocial development and daily life activities by isolating the child from family and society [6]. The functional level of the child with CP and the level of skill in daily living activities are important parameters in determining and monitoring rehabilitation goals or in shaping the rehabilitation program [7]. Quality of life assessment studies, which determine the level of wellness of the individual from physical, psychological, and social aspects and address the awareness of the effects of the disease on daily life in the event of disease, are increasingly important.

Clinically integrated and multidisciplinary treatment approaches are being implemented to improve disease defects, treat children's functions, and make them as independent as possible in the social setting [8]. Physical therapy is needed to improve the physical functioning of children with CP. Rhythmic auditory stimulation has been found to be an effective method of additional conventional physical therapy in the rehabilitation of child or adult patients and the ability to perform rough motor activities. It is suggested that rhythmic auditory stimulation and rehabilitation program will be more beneficial in coordination and muscle control losses especially in children with CP. Rhythmic auditory stimulation is defined as a neurological technique with auditory rhythm and physiological effects in motion control and motor system improvement in the rehabilitation program. Rhythmic auditory stimulation in CP type regulates motor control by stimulating functions in the basal ganglion, cerebellum, and spinal cord levels with difficulty in performing rhythmic movements such as walking patterns [9]. Compared to other methods, music therapy (MT) is a cost-effective, non-invasive method that can easily be applied in any environment. Music is a good tool that attracts children's attention, motivates and strengthens social communication [10]. Rhythm is the basic element of music [9]. Rhythmic musical stimulation is successful in the treatment of diseases such as CP, traumatic brain injuries, Parkinson's, stroke in the rehabilitation of motor diseases. Multiple treatment techniques in neurological MT have beneficial effects on sensorimotor, cognitive, and language speech training. In recent years, music has begun to be widely used for surgical and medical treatments, emotional state in chronic situations, anxiety and pain relief. Listening to music can reduce the severity and frequency of pain by affecting the release of opioid substances [11].

MT is the clinical and evidence-based use of music interventions to accomplish individualized goals within a therapeutic relationship by a credentialed professional who has completed an approved music therapy program. MT interventions can be designed to promote wellness, manage stress, alleviate pain, express feelings, enhance memory, improve communication, promote physical rehabilitation [12]. MT has been one of the

methods used to heal patients since ancient times [13]. Yu et al. observed that blood pressure and heart rate decreased significantly in children who were treated with MT [3]. Heart rate is also the simplest and the most effective way to evaluate the autonomic nervous system. Sympathetic nervous system depression has also shown a reduction in anxiety and depression levels [14]. MT is characterized by rhythmic melodies and functional movements by increasing attention and memory. Music-based therapeutic exercises will functionally reduce dysfunction by acting on the nervous system [15]. MT can be used to ensure the smoothness of movements that need to be done rhythmically and constantly, such as walking. The music during the exercises was observed to increase strength, endurance, and motivation in the extremity muscles in healthy subjects. It has been reported that the exercises made with commands given in the context of simple rhythmic music are more effective. In a study with spastic diplegic children, it was determined that the performance of children was improved in this way [16]. The aim of this study was to investigate the effect of cerebral palsied children who were rehabilitated with MT on the development of gross motor function, pain, and functional independence only in children who were rehabilitated.

Material and Methods

Participants

One hundred and twenty children with spastic CP between ages 5 and 11 years were enrolled in this study. The children were classified according to the Gross Motor Function Classification System. The patients were randomized and divided into 2 groups of 60 people. A randomized list was prepared in a computer environment by a statistician for randomization. In this list, the odd numbers for the control group and the MT group were given double numbers. The group identification is printed on sequentially numbered cards placed in sealed envelopes. After enrollment, the numbered envelope was opened by the patient and the blind investigator. The researcher started the session by placing the proper disc CD player before the beginning of the work. Children from 5 to 11 years of age, who had a spastic type CP diagnosis and were able to understand the commands as co-operative, with no hearing problems between GMFCS levels I and III were included in the study. Acute and chronic infectious diseases, coagulation diseases, progressive cerebral diseases such as neoplasms, inherited diseases such as trisomy 21 syndrome, hearing loss, surgery from the upper and lower extremity in the last 1 year, psychiatric problems, weak cooperatives were excluded from the study.

Study design

Neurodevelopmental therapy was applied in the first group music accompaniment and only the neurodevelopmental therapy was applied in the second group without music. A total of 15 treatments were administered for 5 weeks, 3 sessions per week for all patients. The sessions lasted 45 minutes. Classical music is preferred as a musical style. The exercises performed in the musical accompaniment are made according to the rhythms in the music. The treatment schedule was planned so that the commands given to the illness and the movements required to be removed are made in the presence of rhythms. The age and body mass index (BMI) of all patients were recorded. The children were evaluated with Gross Motor Function Measurement (GMFM-88), WeeFIM for functional independence measurement, Wong-Baker faces pain rating scale (FACES) for pain

intensity before, at the end of treatment and after 3 months of treatment. Outcome measures are described in more detail below. According to the power analysis results, when sufficient the number of participants was reached, the study was stopped. Ethics committee approval for the study was obtained from the Istanbul Science University Ethics Committee for Clinical Researches. The written informed consent was obtained from families of all children.

Outcome measurements

Gross Motor Function Classification System

The gross motor function classification system is a classification system (1997) that was developed in 2007 by Palisano et al. to classify gross motor functions of children with CP. Gross motor function in children with CP, is a standardized method that classifies differences in motor function between sitting and walking in 5 levels. Level 1: Walk independently. There is a limit to advanced gross motor skills. Level 2: Walk without assistive device. There are limitations when walking in society. Level 3: Walk with assistive device. There are limitations when walking in society. Level 4: There is a limit. It's self-contained. It is carried within the community or uses a wheelchair. Level 5: Even if assistive technology is used, mobility is severely limited [17].

Gross Motor Function Measurement

The gross motor functions of children with CP have been evaluated with the Gross Motor Function Measurement (GMFM-88), which has been widely used in recent years. There are 5 main divisions. It consists of a total of 88 items consisting of 17 in the supine, prone position and turning section, 20 in the sitting section, 14 in the crawling-laptops section, 13 in the standing section and 24 in the walking-running-stair climbing section. Score 0- The movement cannot start. 1- Actively initiates a certain amount of movement (<10%) 2- Completely completes the movement but cannot finish (10% - 90%). 3- Completes the movement independently. Each section score is calculated with itself as a percentage, then the five percent score is summed, divided by 5, and the total percentile score is found [18].

Functional independence measurement (WeeFIM)

It is a useful, short, comprehensive method of measuring functional, educational, and socially functional limitations of the children with CP and other developmental disabilities. The WeeFIM includes 6 items in total, 18 items including selfcare, sphincter control, transfers, locomotion, communication, social and cognitive. In performing the functions of each item in these areas, the score is scored from 1 to 7, depending on whether they get help, whether they do it on time, or whether an auxiliary device is needed. When the task is done with help completely 1; 7 is considered to be totally independent, at the appropriate time and in a safe manner. From 1 to 7 points are awarded depending on the amount of the help. Accordingly, scores of at least 18 (fully dependent) and 126 (fully independent) can be taken [19].

Pain

FACES is a pain severity scale that scales from 0 to 10, which can be determined by the child's face expressions without the need for communication that will force them to express the pain they feel when they are 3 years old and older. Zero point means no pain at all, 10 points means severe pain at irresistible levels [20].

Statistical analysis: All statistical analyses were performed using SPSS 22.0 (SPSS Inc. Chicago, IL, USA). Continuous and categorical data are reported as mean \pm standard deviation and number (percentages), respectively. Kolmogorov-Smirnov test was performed to determine the suitability of the data for normal distribution. Wilcoxon and Friedman K tests were used to compare the variables between the intra and inter groups. P value \leq 0.05 was accepted as meaningful for all statistical levels.

Results

Patients participating in the study had the mean age of 7.47 ± 2.38 and a BMI of 14.08 ± 3.15 , indicating that the distributions among the groups were homogeneous ($p > 0.05$) (Table 1).

When the pain evaluations were compared, it was determined that there was a significant difference between the groups at the end of the treatment and 3 months after the end of the treatment, but this difference was statistically significant at the advanced level in the MT group ($p = 0.016, 0.021, < 0.001$) (Table 2).

In the functional independence measures, there was no significant difference between pre- and post-treatment groups, but there was no significant improvement only in the rehabilitation group in the intra-group evaluations, but there was a statistically significant improvement in the MT rehabilitation group ($p < 0.001$) (Table 3).

Compared within the groups, the mean motor function measurements showed significant improvement in favor of the MT group only at the end of treatment and 3 months after the end of therapy ($p = 0.014$), but there was no significant change in any parameters of the control group in the MT group, while sitting, crawling, standing, walking and total score were statistically improved after the treatment compared to before treatment ($p = 0.004, < 0.001, < 0.001, < 0.001, < 0.001$) (Table 4).

Discussion

CP is a disease caused by brain damage that occurs in the process of fetal development and localized in a certain part of the brain. Another method of treatment that has become popular in recent years, while proving the efficacy of neurodevelopmental

Table 1. Demographic characteristics of patients

	MT+NDT Mean \pm SD (n=60)	NDT Mean \pm SD (n=60)	p
Age (year)	7.42 \pm 2.40	7.60 \pm 2.60	0.924
BMI (kg/m ²)	13.61 \pm 3.15	14.92 \pm 3.33	0.504

Mann Whitney-U Test. MT: Music therapy, NDT: Neurodevelopmental therapy, BMI: Body Mass Index SD:Standart deviation.

Table 2. Comparison of inter-group and intragroup pain

	MT+NDT Mean \pm SD (n=60)	NDT Mean \pm SD (n=60)	p
FACES 1	4.28 \pm 2.81	3.40 \pm 2.70	0.573
FACES 2	0.57 \pm 0.93	3.80 \pm 2.77	0.016*
FACES 3	0.71 \pm 1.13	3.60 \pm 2.70	0.021*
p	<0.001**	0.368	

* $p < 0.05$; ** $p < 0.001$. Mann Whitney-U Test, Friedman K Test. MT: Music therapy, NDT: Neurodevelopmental therapy, FACES: Wong-Baker faces pain rating scale, 1: Pretreatment, 2: Posttreatment, 3: After 3 months of treatment, SD:Standart deviation.

Table 3. Comparison of inter-group and intragroup functional independence measurement

	MT+NDT Mean±SD (n=60)	NDT Mean±SD (n=60)	p
WeeFIM 1	53.25±28.03	47.80±26.92	0.712
WeeFIM 2	58.50±28.55	48.00±27.03	0.493
WeeFIM 3	59.25±28.13	48.60±26.36	0.493
p	<0.001**	0.097	

**p<0.001. Mann Whitney-U Test, Friedman K Test. MT: Music therapy, NDT: Neurodevelopmental therapy, WeeFIM: Functional independence measurement, 1: Pretreatment, 2: Posttreatment, 3: After 3 months of treatment, SD: Standard deviation.

Table 4. Comparison of inter-group and intragroup GMFM-88

	MT+NDT Mean±SD (n=60)	NDT Mean±SD (n=60)	p
GMFM-Lying 1	49.78±4.54	43.00±7.61	0.027
GMFM-Lying 2	50.07±3.47	43.00±7.61	0.014
GMFM-Lying 3	50.14±3.20	43.00±7.61	0.014
p	0.368	1.000	
GMFM-Sitting 1	53.92±12.56	48.00±11.24	0.368
GMFM-Sitting 2	55.57±11.02	48.00±11.24	0.164
GMFM-Sitting 3	56.14±10.42	48.00±11.24	0.073
p	0.004*	1.000	
GMFM-Crawling 1	31.71±11.52	36.80±5.35	0.454
GMFM-Crawling 2	34.00±10.98	36.80±5.35	0.815
GMFM-Crawling 3	35.21±10.79	36.80±5.35	0.812
p	<0.001**	1.000	
GMFM- Standing 1	16.71±11.69	19.60±6.02	1.000
GMFM- Standing 2	20.35±12.40	19.80±6.45	0.711
GMFM- Standing 3	22.14±12.03	19.40±6.87	0.676
p	<0.001**	0.607	
GMFM-Walking 1	19.64±17.37	12.00±3.53	0.963
GMFM-Walking 2	22.78±17.77	12.20±3.96	0.377
GMFM-Walking 3	24.57±17.69	13.00±4.63	0.266
p	<0.001**	0.717	
GMFM-Total score 1	34.35±9.85	31.88±6.36	0.355
GMFM-Total score 2	36.55±9.52	31.96±6.49	0.229
GMFM-Total score 3	37.64±9.22	32.04±6.49	0.139
p	<0.001**	0.779	

*p<0.05, **p<0.001. Mann Whitney-U Test, Friedman K Test. MT: Music therapy, NDT: Neurodevelopmental therapy, GMFM: Gross Motor Function Measurement, 1: Pretreatment, 2: Posttreatment, 3: After 3 months of treatment, SD: Standard deviation.

therapies in CP treatment is music therapy [3,10,11]. In this study, we also investigated the effect of MT on the development of gross motor function, pain and functional independence of the children with CP, and found that the rehabilitation program combined with MT improved gross motor development, functional independence and decreased pain in the children with CP. There are few studies in the literature about music therapy applications with neurodevelopmental therapy. MT has been known since ancient times, but it is one of the new methods of treatment for CP. People in ancient times have established a connection between music melody and vital rhythm. Researchers have shown that neural functions and music are closely related to each other and that various musical elements can affect different brain regions. Musical rhythms resonate because of the endogenous rhythms in the human body. Musical activi-

ties are not related to right or wrong movement, thus children with CP are willing to act in the presence of musical sounds. Various musical activities that can be adapted to all different movements of the children with CP can be applied. For example, percussive musical instruments are useful for improving rough and fine motor skills, improving voice and singing respiratory ability, improving string skill for fine motor skills and hand-eye coordination skills. At the same time, the coordination between musical activities, hands, eyes and the brain is beneficial to the faculty. By means of musical instruments, sounds, auditory perception can make a conscious speech and movement skills become appropriate expressive. During MT activities, many activities such as mental level, coordination, communication skills, social skills, emotional status can be improved [8].

It is known that the rhythms in music are effective on the motor system and that they have developed functional movements, motor planning, and motor neuron activation. In the training of the hemiparetic patients, it was found that the rhythmic music had beneficial effects on the parameters such as walking speed, step length, step symmetry, and it could be used during walking training. At the same time, musical rhythms have been shown to have beneficial effects on cerebellar dysfunction, balance, and coordination by acting on the cerebellum, basal ganglion, cortical lobes, corticocerebellar tract, prefrontal and primary hearing cortex [21]. According to the study by Yu et al., it has been reported that children with 30 CP who are treated with acupuncture have more improvement in their cognitive function, speaking skills, motor skills, self-care skills and social participation than only acupuncture children. In the GMFM, score improvement images in both groups indicated that in the creeping, kneeling, standing and walking parameters more improvement was observed in children treated with MT [8]. Kwak et al. reported that ambulations of 25 children with spastic type CP between 6 and 20 years of age who underwent MT during walking training were better [9]. In this study, it was observed that children who were rehabilitated with MT had a 5.6% improvement in sitting, 12.75% in crawling, 37.5% in standing, 26.31% in walking and 8.82% in total compared to rehabilitated children without music in GMFM scores.

In the literature, MT has been reported to have depressive effects on anxiety and pain in children with SP [3,22]. Klassen et al. found that children with CP who underwent medical treatment in their systematic compulsory examination of randomized controlled trial decreased music pain and anxiety in music [23]. Other studies have reported that MT administered in children with CP is good for the emotional state and reduces the level of anxiety [14]. In this study, it was seen that 16.58% of pain complaints were found in children who were exercised with MT, using the sedative effect of the music mentioned in the literature.

Peng et al. emphasized that MT is a useful treatment modality for MT in total and knee extensor muscle strength, mobility and performance improvement in the rehabilitation of children with CP, as compared to the study of 23 children aged 5-12 years with spastic diplegia [24]. Nasuruddin found that a child with 30 SP between 7 and 12 years old had a group MT of 2 groups separated by 2 groups and found that there was more improvement in motor functionalities, cognitive levels, concentration and quality of life in postures of MT children compared to GMFM-66 score [25]. In this study, the level of functional independence was found to increase by 11.26% in the level of independence of children working with MT.

Conclusion

In conclusion, MT, which is applied additionally in the treatment of children with spastic CP, reduces the pain of children more and increases the gross motor functions and functional capacities according to the rehabilitation program applied alone.

Scientific Responsibility Statement

The authors declare that they are responsible for the article's scientific content including study design, data collection, analysis and interpretation, writing, some of the main line, or all of the preparation and scientific review of the contents and approval of the final version of the article.

Animal and human rights statement

All procedures performed in this study were in accordance with the ethical standards of the institutional and/or national research committee and with the 1964 Helsinki declaration and its later amendments or comparable ethical standards. No animal or human studies were carried out by the authors for this article.

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Conflict of interest

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